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# BRIDGE RIVER WATERSHED FISHER (*Pekania pennanti*) ARTIFICIAL REPRODUCTIVE DEN BOX STUDY

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**Fish and Wildlife Compensation Program**

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## Executive Summary

Fishers (*Pekania pennanti*) are the largest obligate tree-cavity user in North America, and trees with characteristics of fisher natal den trees are rare on the landscape. Land management changes to the forest landscape resulting from hydro-electric development, insect infestations, forest-harvest activities, and large-scale fires is likely to have decreased the supply of these elements. To address the loss of reproductive den trees, this study designed, installed, and monitored the use of an artificial reproductive den boxes for fisher.

Two den box designs were tested for thermal properties prior to being installed in the field. The two designs were a solid wood design with sides constructed of 38 mm thick spruce (laminated 2 x 6" lumber) and a layered plywood design (sides composed of two 19 mm thick pieces of plywood and a 19 mm rigid foam core). The inside dimensions were 28.5 cm by 28.5 cm with a box height of 95 cm. Both the lids and bottom were constructed of the same materials as the sides. A circular 10 cm diameter opening was created near the top of each box and 15 cm of wood shavings were placed in the bottom. Temperatures inside the solid wood and insulated plywood designs were compared over a 2-week period in early April when fisher typically use natal dens. A 7.5 W bulb was used in each design to provide a heat source that would represent fisher kits. The insulated design had greater buffering capacity than the solid design with cooler daytime and slightly warmer nightly temperatures. The solid design more closely tracked ambient temperatures outside the boxes and sometimes had warmer daytime temperatures, which could result in heat stress for young kits. Based on these results the insulated design was chosen to proceed with the project.

Twenty-five insulated den boxes were installed on trees in the Bridge River Watershed in the fall of 2013. The boxes were hung using plastic coated wire and clamps at approximately 3 m from the ground. In December 2013, lure was hung at the box locations to increase the probability of fisher visiting the site. Each box had a hair snagger at the entrance and 10 trail cameras were rotated between the boxes for monitoring. Three follow-up visits were conducted to examine the boxes for signs of use and rotate the location of the cameras. Most boxes showed evidence of use by red squirrels (*Tamiasciurus hudsonicus*) with some having minor chewing damage. Four samples of hair thought to be from fisher were collected and two have been verified by trail camera. One other sample is thought to be from a marten (*Martes americana*). Both fishers observed on camera looked inside the box, but did not attempt to enter. Cameras have been left at all boxes where a mustelid is thought to have visited. Hair samples will be sent to a commercial laboratory to verify the species, sex, and identity.

In the 2014-15 field season, we will continue monitoring of the den boxes and employ strategies to increase the probability of fisher use of the structures. We will explore the use of new lures and bait to attract and entice fisher into the boxes. Den boxes that have not seen use and had no fisher sign seen in the vicinity will be moved to a more promising location. The project will also be expanded to the Cariboo-Chilcotin with funding from the Habitat Conservation Trust Foundation. This will effectively double the sample size to 50 den boxes. Finally, documenting use of the boxes by fisher is likely to require these measures as well as time for fishers to discover and acclimatize to the structures.

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## Introduction

Fishers (*Pekania pennanti*) are forest-dependent carnivores in the weasel family that are an important component of healthy ecosystems. Several aspects of the ecology of fishers, including their use of rare structural elements found primarily in late-successional forests, make them susceptible to changes to the forested landscape resulting from hydro-electric development, forest-harvest activities, and oil and gas development. As such, fishers are considered a species at risk under the Identified Wildlife Management Strategy and are blue-listed (S2S3) in British Columbia. Fishers are a high priority for conservation efforts, as they are considered rank 2 under Goal 3 of the provincial Conservation Framework: Maintain the diversity of native species and ecosystems.

Fishers are also the largest obligate tree-cavity user in North America, requiring trees that have cavities >30 cm inside diameter as reproductive dens during the rearing period (Weir and Corbould 2008). In British Columbia, reproductive dens are found in large-diameter black cottonwood, balsam poplar, trembling aspen, lodgepole pine, and Douglas-fir trees (Weir and Corbould 2008, Weir 2009, Davis 2009), which are most common in late-successional ecosystems. The development of trees that support suitable cavities for fishers is uncommon and these critical habitat elements are likely rare across the landscape.

This project provides a unique opportunity to apply the knowledge gained from research funded by Wildlife Compensation Programs of BC Hydro (e.g., Davis 2012, Davis and Weir 2011, Weir and Corbould 2008) and build recovery tools for fishers in areas where their habitat has been impacted. At a broad scale, the Gun, Tyaughton, and Yalakom watersheds of the Bridge River drainage are rated as having medium to high capability for fishers (Lofroth 2004). Flooding of the Bridge River Valley by the Carpenter and Downton reservoirs likely removed many of the large, cavity-bearing trees that fishers may have used for reproductive dens. This would have affected the supply of critical denning structures for the fisher population that occurs in the area immediately surrounding these reservoirs. Furthermore, the ability of the landscape to support sustainable populations of fishers may have been reduced because fewer quality cavity-bearing trees may occur on upland sites. Recent large wildfires in the assessment area may have further reduced the availability of denning structures.

Previous work on fishers in the watershed (Davis 2012) has estimated that there are 0.45 trees/ha with features of reproductive dens in the remaining high value habitats. The removal of many denning opportunities may have affected recruitment rates within the population and therefore the ability of the population to sustain itself. To potentially mitigate the footprint impacts of these reservoirs on fishers and their reproductive habitat, an increase in the supply of reproductive dens is needed. Work in the United Kingdom has found that artificial den boxes are used by pine marten (*Martes martes*) in that country (Messenger *et al.* 2006). We will determine if a similar structure will provide a den box that fisher will use for natal denning.

## Goals and Objectives

The objectives of this multi-year project are three-fold. Firstly, we propose to develop a den box design that accommodated fisher reproductive needs. Secondly, to assess the use of the den boxes by fisher. Lastly, attributes affecting the successful use of den boxes by fisher will be analyzed. Information from this project will provide BC Hydro and the St'át'imc Nation with better data upon which to evaluate mitigation options to augment reproductive habitat for this species.

## Study Area

The 990-km<sup>2</sup> Bridge study area lies within the Gun, Tyaughton, and Yalakom drainages to the northwest of Lillooet, BC and occurs within the Southern Chilcotin Range and Central Chilcotin Range ecosections. The assessment area includes the dry-cold Montane Spruce (MSdc3), very dry-cool Montane Spruce (MSvk3), dry-cold Interior Douglas-fir (IDFdc), and dry-very cold Engelmann Spruce-Subalpine Fir (ESSFdv2) biogeoclimatic units. The assessment area encompasses portions of 3 registered traplines and occurs within the traditional territory of the St'át'imc Nation.

## Methods

### *Den Box Design*

Two den box designs were developed to assess thermal properties that may be important to fisher. The box designs were: 1) a solid wood box using laminated 3.8 cm by 14 cm (2 x 6 inch) spruce and (2) a box constructed using layered 19 mm (3/4 inch) plywood and 19 mm rigid insulating foam (i.e. two pieces of plywood with foam between)(Figures 1 and 2). Both boxes had an inside diameter of 28.5 cm and a height of 95 cm with lids constructed of the same material as the sides. A circular 10 cm diameter opening was created near the top of each box. The internal size and entrance hole were created to replicate the approximate dimensions at fisher dens found in the field (Davis 2009; Weir *et al.* 2012). Each box had 15cm of wood shavings placed in the bottom.

A 7.5-watt bulb housed within a 23 cm diameter round tin box was placed in the bottom of each den box design. Two thermo couplers were placed in corners of the den box around the tin and two were placed outside the boxes to measure ambient temperature. Temperatures of the den boxes were monitored every 30 minutes during early April in Williams Lake, BC. The choice of den box for the study was the design with the best thermal retention properties.

### *Installation and monitoring*

High value habitats for fisher denning were identified using information from previous work on fisher in the Bridge Watershed and information from the Fisher

Habitat and Forest Management Web Module<sup>1</sup>. Known areas with fisher from the DNA based inventory conducted in 2012 (Davis 2013) and habitats more likely to contain reproductive denning habitats were identified on maps. Suitable locations for den boxes were identified in forest stands containing stable trees that could not be seen from roads and in areas that were not likely to be logged (e.g. live trees in riparian zones, wildlife tree patches, etc). At each location, data associated with a medium-sized territorial carnivore detection station was collected (BC Ministry of Environment Lands and Parks 1998).

The den boxes were erected following the methods used in the UK (Messenger *et al.* 2006). The boxes will be mounted in trees at a height of ~4m to reduce the chances of disturbance by ground based predators and humans. Two wraps of steel stranded, plastic coated washing line and wire rope clamps were used to mount the box to a suitable tree (Figures 3 and 4). Commercial fisher lure (Hawbak's Fisher Lure) was used at each site to increase the probability of fishers finding the den box.

Monitoring will use a combination of motion detection cameras, fisher DNA, and observations of wildlife sign at the den boxes locations. Seven cameras were used to monitor wildlife use of the structures with the cameras moved between den boxes on each visit. A wildlife permit was obtained to allow the collection of hair samples (VI13-91889). At the entrance hole of each den box, a 30 calibre bore brush was anchored to the side of the hole using a 5cm metal plate to snag hair from fisher entering the den box (Figure 5). The final den box design used a rectangular opening (7 x 12 cm) that better mimicked the size of entrance holes to fisher natal dens observed in the field (Davis 2009, Weir and Corbould 2008). As well, each site will be examined for signs of fisher use such as feces, claw marks, and tracks. Marten have been found to defecate on top of den boxes and at the base of the tree in the UK (Messenger *et al.* 2006). Fisher natural den sites also often have feces at the base of the den tree (Author, personal observations).

When the breeding season is near (late March), cameras were moved to monitor den boxes that received the greatest attention from fishers to increase the likelihood of documenting reproductive use of the structures. Den boxes that are used by fishers may also be examined using an endoscope to document the presence and number of kits. This will only be attempted when the female is known to be absent from the den box (e.g. verified using the camera).

## Results

The temperatures recorded by each set of paired probes differed by <0.3 °C and were averaged for analysis. Over the monitoring period, mean temperatures in the two den box designs were warmer than ambient temperatures and the solid design had the warmest microenvironment (Table 1). Graphs comparing the designs show that the solid design closely tracked ambient temperature, but was sometimes

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<sup>1</sup> Fisher Habitat and Forest Management Web Module. Available at [fisher.forrex.org](http://fisher.forrex.org).



**Figure 1. Wafer design for den box with 19 mm insulation layered between 19 mm plywood.**



**Figure 2. Comparison of thermal properties between the two den box designs.**



**Figure 3. Tin box housing 7.5 W light bulb and thermocouples used to test thermal regime of the boxes.**



**Figure 4. Wafer plywood design den box mounted on tree using plastic coated wire and clamps.**



**Figure 5. Detail of bore brush installed to collect hair from animals entering the den box.**



**Figure 6. Detail of bore brush with hair sample from the 2013-14 Bridge Watershed.**

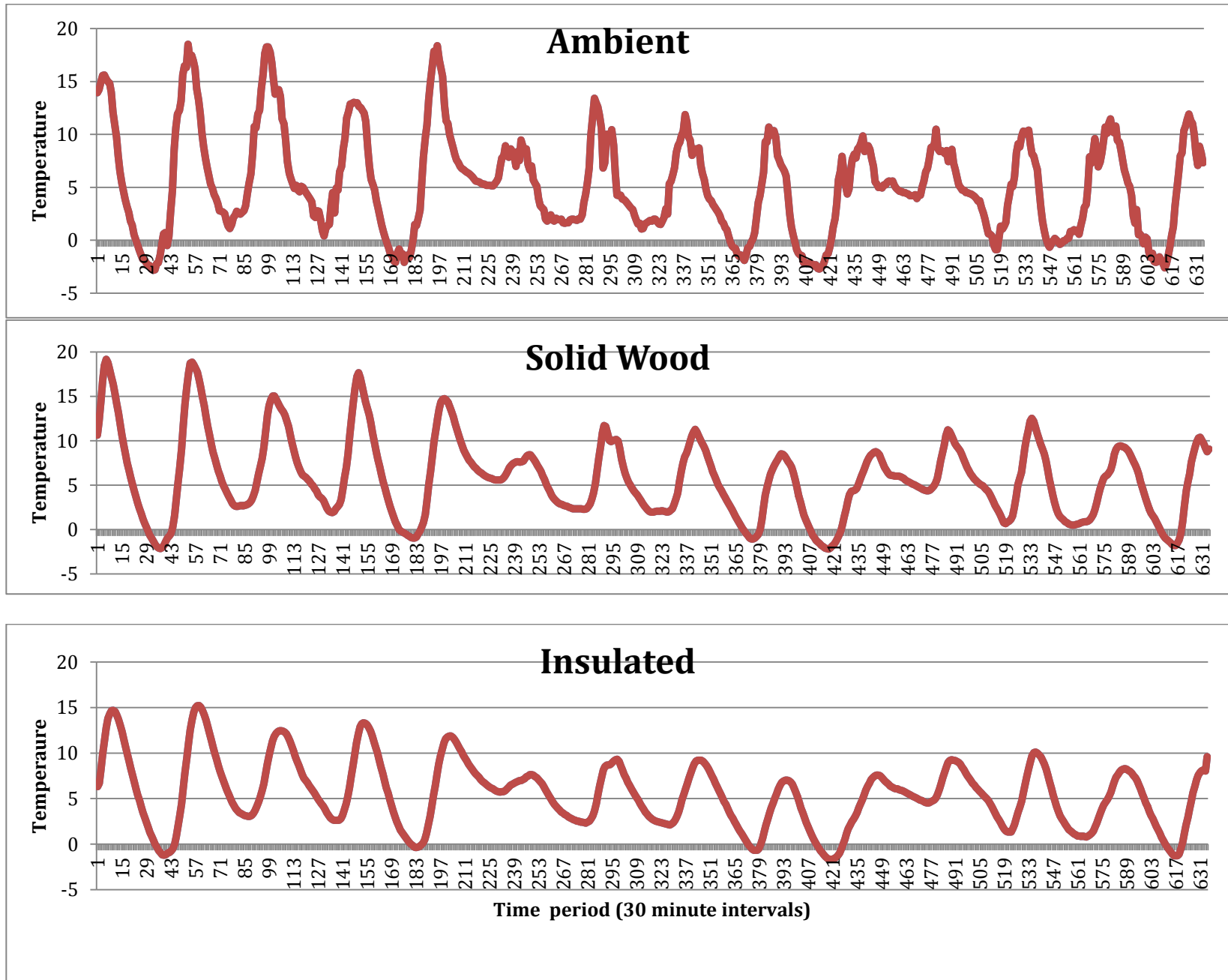


Figure 7. Graphs comparing temperature (°C) inside solid wood and insulated denbox designs with ambient temperature.

warmer than temperature outside the box during daytime hours (Figure 7). The insulated design had a more moderated temperature environment with slightly cooler daytime temperatures and warmer temperatures at night than either the solid wood design or outside the den boxes. Temperature characteristics of the designs during periods of cold weather (e.g. when either ambient temperature or temperatures inside den boxes were  $<0^{\circ}\text{C}$ ) were compared to examine performance of the boxes during a season when fishers are likely to be stressed. Insulated boxes maintained a small, but significantly ( $\alpha = .05$ ) warmer temperature than the solid design during cold periods (Table 2).

**Table 1. Comparison of temperatures ( $^{\circ}\text{C}$ ) in den box designs monitored between 31 March – 13 April 2014 in Williams Lake, BC.**

	Mean	SE	Minimum	Maximum
<b>Ambient</b>	5.3	0.19	-2.8445	18.521
<b>Insulated</b>	5.5	0.15	-1.6845	15.2345
<b>Solid wood</b>	5.8	0.18	-2.2035	19.1865

**Table 2. One way analysis of variance on temperatures ( $^{\circ}\text{C}$ ) during cold weather periods (e.g. periods when either ambient or temperatures inside den boxes were below zero) in insulated and solid den box designs monitored between 31 March – 13 April 2014 in Williams Lake, BC.**

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	63.3	63.3	20.622
Error	240	736.5	3.1	Prob > F = <.0001
C. Total	241	799.8		

Level	Mean	SE
Insulated	1.07	0.159
Solid	0.05	0.159

Based on the testing, twenty-five insulated den boxes were placed in the Gun (6), Tyaughton (14), and Yalakom (5) watersheds during the fall of 2013 (Appendix 1). Due to budget constraints, only four field visits to the den boxes were possible after the initial installation. Most den boxes were placed in riparian forests next to streams, with some protected in the Wildlife Habitat Areas previously delineated in the Bridge River Watershed (Davis 2012). The majority of den boxes are located in the IDFdc BEC zone (22) with the remainder in the lower MSdc. The areas chosen for den boxes were also selected for the connectivity present to large areas of mature forest.

The den box sites had commercial lure applied in mid December 2013 followed by field visits in January, February, and April 2014. We were not able to access all den boxes on the April 2014 visit due to field conditions. Trails on some south facing slopes were bare of snow, while in other locations deep melting snow made travel impossible. The 5 den boxes that were not accessible will be examined in June for signs of use when the yearly monitoring of den box condition occurs.

Evidence of squirrel (*Tamiasciurus hudsonicus*) was observed at most sites with approximately 50% of the boxes having some minor chewing damage. We found 4 hair samples thought to be from fisher (Figure 6) and one that is thought to be a marten (*Martes americana*). Two of the fisher samples were verified by trail cameras (Figures 7 and 8) and 2 of the fisher samples came from a single den box (DB23). At the end of the April 2014 field visit, cameras were left at all sites where a mustelid was thought to have visited. Hair snag samples from this winter will be sent to a commercial laboratory for identification to species, sex, and individual identity this summer.

## Discussion

Fisher natal denning occurs during the early spring when temperatures can still be very cold at night. In the Chilcotin, Davis (2009) recorded temperatures of -17° C at fisher natal dens during nights in April. Fisher kits are born altricial with only a sparse covering of hair, and females spend time away from the den to forage and mate (Weir and Corbould 2008). Given this, tree cavities may be chosen in part to provide a protected microclimate (Raley et al. 2012). Studies have documented tree cavities having more stable and narrower fluctuations in temperature when compared to ambient temperatures (Weir and Corbould 2008, Coombs et al. 2010, Gruebler et al. 2013). Gruebler et al. (2013) compared temperature regimes between tree cavities and un-insulated artificial nest boxes and found that the nest boxes had much lower buffering capacity even when artificially heated. The results observed here indicate that insulating den boxes has a significant buffering effect on temperature regimes and this may increase the chances of fisher occupying the boxes.

It would have been desirable to compare the designs through a colder range of temperatures and with different levels of internal heat that may better reflect fisher energy output. However, the timeframe for deciding on a design was limited due to the scheduling for the start of the project (i.e. the project started in April when forecasts for temperatures were rising). Despite this, our results show a small but significant difference in temperature between den box designs at temperatures that could be extrapolated to colder periods. Further, the buffering effect of the insulated design when temperatures are warmer may also be of benefit for fisher by preventing overheating of kits before the young are mobile.



**Figure 8. Fisher looking into den box (DB9) near the Yalakom River.**



**Figure 9. Fisher looking into den box (DB23) near Tyaughton Lake.**

We were successful in attracting fisher to den boxes in the Bridge Watershed. The sex and identity of fishers will be determined in the summer of 2014 and compared with results from the DNA-based inventory for fishers in 2012 (Davis 2013). At this time, none of the fishers viewed on trail cameras entered the den boxes; however, fishers may use the boxes over the summer period. To continue monitoring fisher, we have left cameras at all locations thought to have fisher or marten visit, and all boxes have hair snaggers installed. There are also five boxes that we were unable to visit in April, and data collected later in the summer of 2014 may reveal more den box use. Despite this, strategies to increase the number of den box visits and raise the likelihood of a fisher entering a den box must be explored.

## **Recommendations**

Several avenues to increase the probability of fisher use of denboxes will be employed in the 2014-2015 field season. The commercial fisher lure used in the 2013/2014 field season was the same as in the 2012 DNA-based inventory. However, the viscosity of the lure was much lower than in the past and we had to increase the thickness (i.e. by adding beaver castor) to ensure it would stick in the field. For the next field season, we will consult with other researchers to produce our own lure that may be more attractive to fishers. The 2012 DNA-based inventory also used bait to attract fishers and we will try fastening a chicken wing inside the box. Winter is a time period with increased energetic demands and the bait should entice the animals to enter the box. Fishers entering the box to obtain food may be more likely to use the box again in the future for shelter. We also made note of any fisher sign in the vicinity of the boxes during this field season, and boxes that had no nearby activity will be moved to a more promising location. Finally, the project will also be expanded in 2014-2015 with additional funding from the Habitat Conservation Trust Foundation (HCTF). This will allow us to double the number of den boxes deployed in the field and expand to the Cariboo-Chilcotin where fisher are also relatively abundant.

## **Acknowledgements**

I would like to acknowledge the contributions of Tolko Industries Ltd and West Fraser Mills Ltd in supplying labor and material for the construction of den boxes. Matt Manual and Ed Serr of the St'át'imc Nation provided administrative and field support respectively. Lastly, I would like to acknowledge the financial support provided by the Fish and Wildlife Compensation Program for this project.

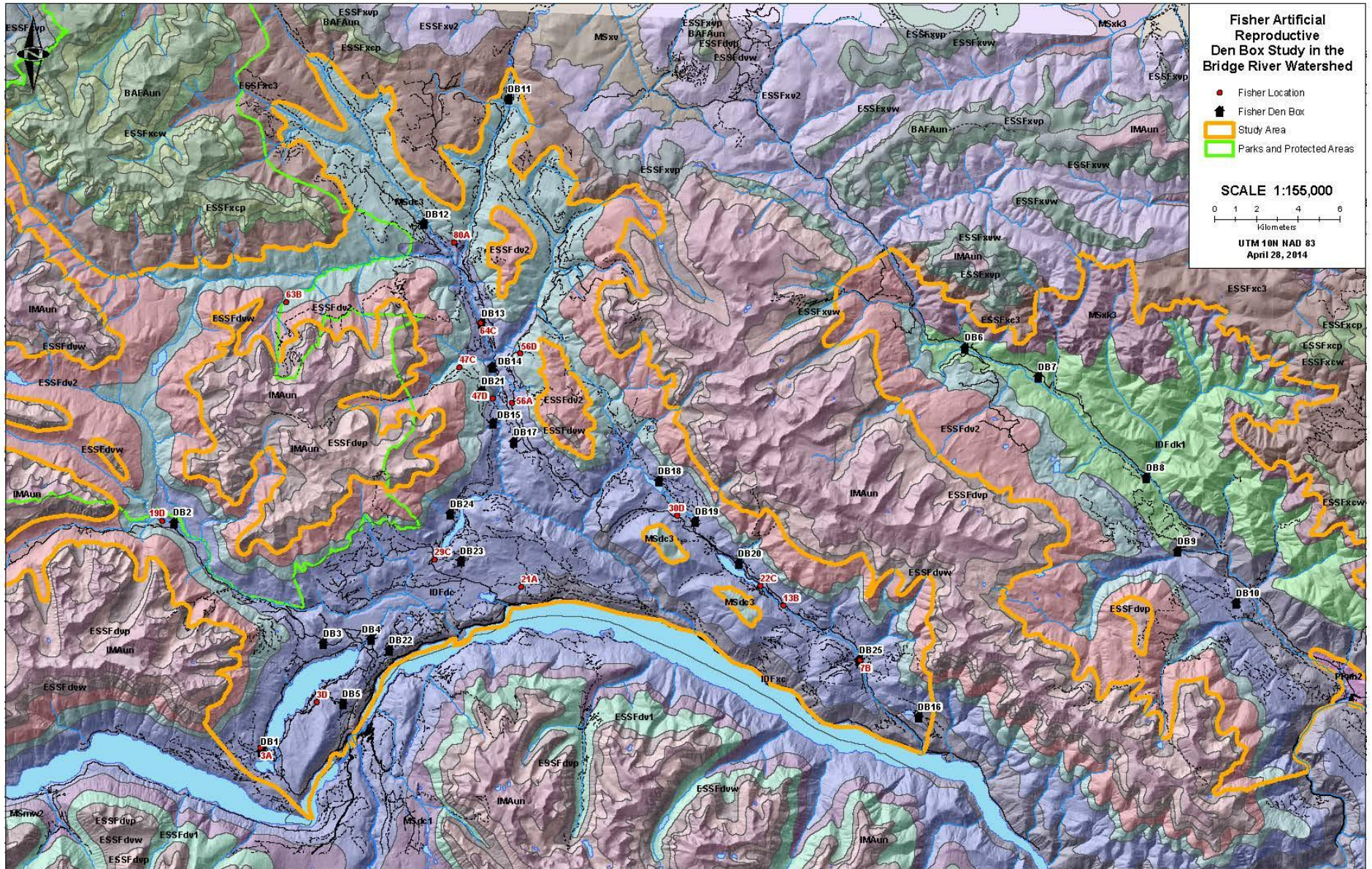
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# Appendix 1. Map of Bridge Watershed Study Area



## Appendix 2. Financial Statement

	BUDGET		ACTUAL	
INCOME	FWCP	Other	FWCP	Other
<i>Total Income by Source</i>	35280	46630 <sup>2</sup>	21168	10850
Grand Total Income (FWCP +other)	81910		45998.73	
	BUDGET		ACTUAL	
LABOUR EXPENSES	FWCP	Other	FWCP	Other
Biologist (Davis Environmental Ltd)	18900	18900	18309.38	
Statimc Technician (contractor)	8125	8125	3962.5	
Technician (Davis Environmental Ltd)			1750	
Government Biologist (volunteer)				800
Statimc Coordinator (volunteer)				1000
Total:	27025	27025	23903.75	1800
MATERIALS & EQUIPMENT				
Mapping	750	750	173.25	0
Materials donate	0	2500	0	2500
Materials purchased	500	500	1991.41	0
Truck rental	1125	1125	1875	0
ATV rental	1680	1680	2226.5	0
Trail cameras	0	3500	0	3500
GIS Map data	0	500	0	500
DNA analysis	0	500	0	0
Fuel	1312.5	1312.5	2223.29	0
Field Accommodations	2187.5	2187.5	2100	0
Meals	700	700	655.53	0
Sled deck	0	700	0	700
Totals	8255	15955	11244.98	7200
Office Equipment	0	1350	0	1350
Camera rental	0	50	0	50
Woodworking shop	0	450	0	450
(List others as required)				
Totals	0	1850	0	1850
<i>Total Expenses</i>	35280	44830	35266.86	10850
<i>Grand Total Expenses {FWCP +other}</i>	80110 <sup>2</sup>		46116.86	
BALANCE OWING	0		-14,098.86	

<sup>2</sup> Note that we did not receive funds from HCTF for the 2013-2014 field season.

### Appendix 3: Performance Measures

Performance Measures – Target Outcomes - Continued													
Project Type	Primary habitat benefit targeted of project (sq.m.)	Primary Target Species	Estuarine	In-stream Habitat – Mainstream	In-stream Habitat – Tributary	Riparian	Reservoir Shoreline Complexes	Riverine	Lowland Deciduous	Lowland Coniferous	Upland	Wetland	Other
Maintain or Restore Habitat forming process													
Artificial gravel recruitment	Area of stream habitat improved by gravel placement												
Artificial wood debris recruitment	Area of stream habitat improved by LWD placement												
Small-scale complexing in existing habitats	Area increase in functional habitat through complexing												
Prescribed burns or other upland habitat enhancement for wildlife	Functional area of habitat improved												
Habitat Development													
New habitat created	Functional area created												
Other													
New habitat elements created	25 Den Boxes installed	Fishers ( <i>Pekania pennanti</i> )				X			X	X			

## **Appendix 4 Confirmation of FWCP Recognition**

Over the course of fieldwork in the study area we stopped and discussed the project with people living and working in the area. There is local concern regarding the effects of forest harvesting that has recently resumed in the area. Several phone calls were fielded from concerned residents and community organizations in the Bridge Watershed regarding the effects on fisher and fisher habitat. In all cases, we identified FWCP as the funding agency for the work and discussed fisher habitat needs in the area. All discussions of the project were positive with people generally very interested in the work and asking where they could find our reports. Other examples of recognition are outlined below.

### ***Community Outreach***

- An interview was given to the Wilderness Stewardship Foundation on the project. FWCP is recognized in the resulting article as the funding source for the project (see below).
- Updates and photographs on this project have been placed on the *Phat Weasels* facebook page. Again, FWCP has been recognized as a funding source for this project.

### ***Communication of Results to Government, Industry, and Academia***

- Information on this project has been communicated to researchers in government and the private sector at the yearly Weaselfest Workshop at the John Prince Research Forest in September 2013.
- Forest companies in the Bridge River Valley (Aspen Planners) and Cariboo-Chilcotin (West Fraser Mills and Tolko) are interested in the project and have received updates. The location of den boxes has been provided to the companies to prevent impacts on the research.

## **Local Research: Fisher (*Martes pennanti*) Studies**



The fisher is a small carnivore about the size of a house cat belonging to the weasel family. They prey on snowshoe hare, chipmunks, squirrels, fawns, and even porcupines. They are widely distributed in BC but are one of our rarest predators. This rarity is a result of several factors. Firstly, for a small mammal, they possess very large home ranges, particularly in BC. This results in them having a naturally low density. Secondly they have a relatively low reproductive rate and low infant survival, so the population growth rate is low. Finally, they possess a luxurious dark-brown fur which has made them

a target of the fur trapping industry.

The fisher has particular habitat requirements. They need large complex habitats that have few open areas and tall canopies. They are most often found in late successional forests which have more canopy cover and greater diversity of tree species that suit their multiple life cycle needs. Fishers use different habitats within their range for foraging, resting and rearing young. They use large diameter trees with heart rot for nesting and rearing young. The supply of suitable trees is thought to be limited, especially in locations where flooding, fire, and forest harvesting have affected large areas of suitable habitat.

In 2013, a project was initiated by researcher Larry Davis (of Davis Environmental Ltd) to examine the use of artificial den boxes for fisher in the Bridge River Watershed. This work extends on past research in the area, including a DNA-based inventory that identified the Gun, Tyaughton, and Marshall Lake valleys as core fisher habitat. They constructed 25 wooden den boxes (approximately 1m tall by 37 cm wide on each side) that have been attached to trees in habitats that fisher regularly use for denning. The boxes are monitored over the winter using cameras and hair snaggers. Fishers have their young in April and they hope to find some examples of fishers using the boxes for raising their young. To date, only one box that is receiving regular visits by a fisher, but the animal has not entered the box and it may take time for the animals to use the structure. They have received funding from BC Hydro's Fish and Wildlife Compensation Program and the BC Habitat Compensation Trust Foundation to continue this research and hopefully will observe fisher use of the boxes over the next year. Photographs and updates to this project can be seen on the [Phat Weasels Facebook page](#).